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Surface Condition of Soil and Time of Application as Related to Intake of Water

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United States Department of Agriculture, Soil Conservation Service, in cooperation with the Nebraska Agricultural Experiment Station

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INTRODUCTION

From April to October 1938 tests were made on the intake of water by 8 soils at 10 different locations in southeastern Nebraska, having various surface conditions and different degrees of slope. A description of the methods used and a summary of the results of this study were reported by the authors in a recent publication.[1] The data for representative tests on two of these soils, Marshall silt loam (heavy subsoil) and Lancaster sandy loam, are discussed in detail in this circular. These tests were selected because these two soils have widely different profiles and because a larger number of tests were made on these than on some of the other soils. That the results are similar to those obtained on the other six soils is shown by the summaries given in the earlier publication of the Nebraska Experiment Station and by the tabular data for the 10 locations given in table 5, p. 25.

The curves representing the rates of intake and run-off at different time intervals and for different surface conditions for these two soils are shown in figures 1 to 25. Since there is a large number of readings in the tests on these soils it has been considered inadvisable to include

[1] Duley, F. L., and Kelly, L. L. Effect of soil type, slope, and surface conditions on intake of water. Nebr. Agr. Expt. Sta. Res. Bul. 112, 16 pp., illus. 1939.

all the data. The few examples given have been selected to bring out the essential conclusions derived from the entire experiment. The general summary tables in the appendix give some information as to total intake but do not show the rate of intake at different times during the period of application.

Water was applied with a sprinkling device consisting of an overhead supply pipe about 6 feet above the ground provided with fan-shaped garden-sprinkler nozzles directed downward. These gave a reasonably even distribution of water over the 6.6- by 33-foot plot when the pipe carrying the nozzles was oscillated through an arc of about 60°.

The amount of water added to a plot was measured through a special water meter that could be read to 0.1 cubic foot. The run-off was caught in a two-compartment tank calibrated to 0.001 inch of run-off from the plot area. Plots were bordered with a metal or wood frame that extended 6 inches into the ground. No attempt was made to prevent lateral seepage in the soil below the plot boundaries. With prolonged applications this lateral movement was sufficient to account for a considerable amount of water. For plots on which the intake was small the error due to this factor was considered negligible. The results given in this circular, therefore, are to be considered as reflecting, for the most part, the rates at which water passed through the surface soil on a plot of limited area rather than the rates at which it might pass into the subsoil under prolonged natural rainfall conditions. Under the conditions of the tests the water did penetrate readily the subsoils, but most of them were relatively dry when the tests were begun.

Except for one group of tests on native sod, the tests were made on old land that had been cultivated for 50 to 60 years. The results given for a bare soil were obtained on ground that had recently been spaded and worked down to a fairly smooth surface about like that of a garden bed. Debris was removed from the surface with a garden rake.

The intake rate on the plots is assumed to be the difference between the rate of application and the rate of run-off. During the early stages of the test this would include a certain amount of surface detention and depression storage.

It is to be understood that although 10 different locations were used in this study and the soils ranged from sandy loam to clay loam, no attempt is made here to apply the results to other soil types or to any of these soils in other localities.

INTAKE OF WATER ON BARE CULTIVATED AND STRAW-COVERED PLOTS

Marshall Silt Loam (Heavy Subsoil)

Bare Cultivated Plots. (Location E, plot 2, tests 1–4; figures 1–3.)

The results of the first test on plot 2 on the Marshall silt loam, August 3, 1938 (fig. 1), show that with an average application of 1.59 inches an hour on bare soil cultivated to a depth of 6 inches, run-off

did not start for 65 minutes. The soil was very dry and cloddy. Thereafter run-off increased fairly rapidly, following a slightly S curve. By the time the application had continued for 3 hours the rate of run-off had become almost constant at 1.1 inches an hour and the infiltration rate had also become nearly constant at about 0.5 inch an hour. At the end of the run of 5.75 hours the infiltration rate had gradually decreased to slightly more than 0.3 inch an hour. After the application on the bare soil had been stopped the run-off dropped very rapidly and ceased completely in 4 minutes.

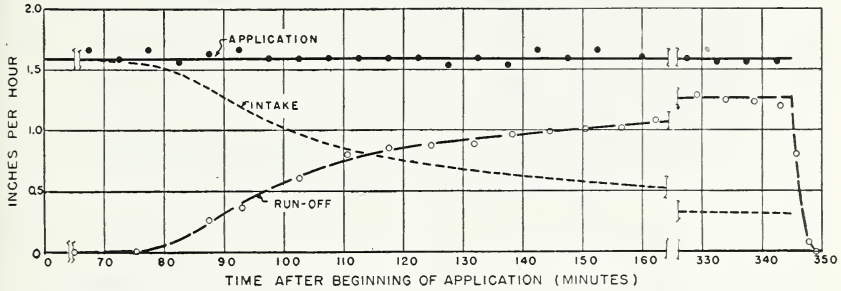

FIGURE 1.—Intake and run-off on Marshall silt loam (heavy subsoil), Lincoln, Nebr., location E, plot 2, test 1: Bare cultivated land. August 3. Soil dry.

Data from a second test the following day gave a different type of curve. Run-off started in 2.75 minutes because the soil had been compacted[2] by the application of the previous day. The intake curve dropped rapidly, but the final readings indicated were too low because of natural rain falling on the plot during the test. After the rain was over, or about 1 hour after the measurement had been stopped, water was again applied. Run-off began in 1 minute and 40 seconds (fig. 2). That there was very little depression storage, as defined by Horton,[3] is shown by the fact that run-off began in so short a time, after only 0.045 inch of water had fallen. The infiltration rate dropped very quickly and after 10 minutes was nearly constant. The final rate was only 0.21 inch an hour. A part of the water needed to bring the infiltration rate down to that indicated by the flat part of the curve must have been used in filling the pores of the surface soil, from which the excess gravitational water had percolated.

The results of the next test on this plot, shown in figure 3, further indicate that a relatively large amount of water was absorbed at this test before run-off started and before a nearly constant rate of intake was reached. This was due to the fact that the soil had dried for 2 days and numerous check cracks had formed in the compact surface layer. The relatively dry and checked surface permitted a high rate of absorption for 10 to 20 minutes.

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[2] The authors have previously described the formation of a compact surface layer when drops of water fall on bare soils, which seems to explain the loss of intake after water has been falling on cultivated bare land for a short time. See footnote 1 and DULEY, F. L. SURFACE FACTORS AFFECTING THE RATE OF INTAKE OF WATER BY SOILS. Soil Sci. Soc. Amer. Proc. 4:60–64, illus. 1939.

[3] HORTON, ROBERT E. SURFACE RUN-OFF CONTROL. *In* Headwaters Control and Use, Upstream Engin. Conf. 1936, pp. 16–49, illus. Washington, D. C. 1937.

There were practically no depressions left at the end of the previous run, August 4, since by that time any depressions that may have been present had been filled by soil material or were broken on the lower side, so that there was practically no capacity for holding water in depressions on the surface at the time of the test on August 6.

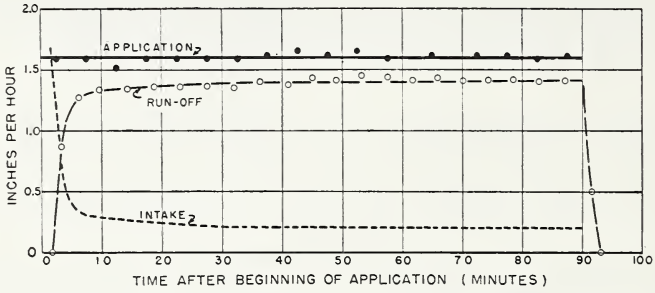

FIGURE 2.—Plot 2, test 3, August 4. The second test was lost on account of rain.

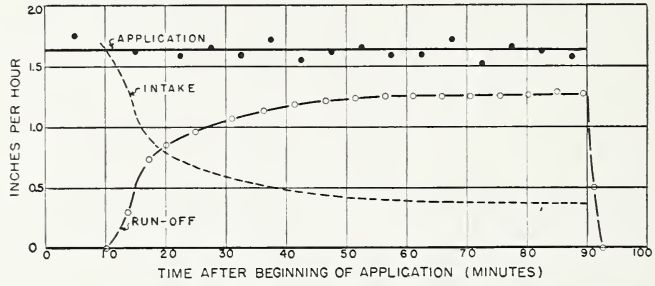

FIGURE 3.—Plot 2, test 4, August 6, 2 days after the third run (figure 2). Note the longer time required for run-off to begin.

Much consideration must be given to the sloping part of the curves and also to the fact that during the first 10 minutes all the water applied was absorbed. There was no run-off until 0.27 inch of water had been taken into the soil. The total quantity absorbed from the amount applied in 90 minutes was 0.97 inch, whereas if the final rate of intake had prevailed for the entire period of application the quantity absorbed would have been only 0.52 inch.

The average intake rate for the period of the test was 0.65 inch. This figure, however, has little value since such an average must include the high rate of intake for a short period at the beginning of the test and also the long period of low intake toward the end. A figure giving the average intake for the time of the test is, therefore, not representative of what took place over any particular period but is rather the mean of two very unequal rates that were acting for unequal periods of time. If the test had been stopped 30 minutes earlier or continued this much longer, the average rate would have been very different.

It should be further noted that the infiltration rate shown by these

curves does not become constant but approaches very nearly a constant value. In nearly all tests the infiltration curve has continued to show at least a slight downward trend throughout the period of the run. In a relatively few tests, as illustrated in figure 22, there was a slight rise in the intake rate after a minimum had been passed. This was not considered to be of much significance in these studies. On most plots where the application of water had been stopped for a few minutes, a few hours, or a day, and the application again resumed, the rate at which the intake became nearly constant was found to be lower than at the previous application. However, if the plot stood for several days and another application was made, the rate of intake usually became approximately constant at a point higher than the nearly constant rate of the previous test. This occurred in spite of the fact that the soil below the surface 6 inches was doubtless wet approximately to field capacity during this interval. This increase in intake upon long standing appears to be due to the rupturing or alteration in structure of the compact layer at the surface by prolonged drying.

Straw-Covered Plots. (Location E, plot 2A, tests 1–4; figures 4–5.)

Following the applications of water on the bare cultivated plot 2 on August 3–6, the plot was allowed to dry for 2 days. On August 8 the soil was raked heavily with a garden rake to a depth of about 1 inch to break the surface crust. After this heavy raking the plot was covered with wheat straw at the rate of 2.5 tons an acre, after which it was designated as plot 2A.[4]

Water was then applied at the rate of 1.68 inches an hour for 6 hours—a total of 10.08 inches—with no run-off. The next day, water was applied at the rate of 1.60 inches an hour for 5 hours—a total of 8.00 inches—with no run-off. It should be noted that this is the same plot as shown in figures 1 to 3, which in a bare cultivated condition had a final intake rate of only 0.21 inch an hour. Fifteen minutes after the end of the 5-hour test, the rate of application was increased to 3.29 inches an hour. The intake and run-off with this heavy application are shown in figure 4. Because of mechanical difficulties the test was discontinued at the end of 1 hour. The infiltration rate at the end of this test was about 1.90 inches an hour, and the curve indicates that the rate had become fairly constant. The following day, August 10, water was applied at an average rate of 3.46 inches an hour for 2 hours (fig. 5). At the end of this test the infiltration rate was 1.20 inches an hour.

A summary of all applications on August 8 to 10 shows that water had been applied during a total of 14 hours. In this time 24.46 inches of water had passed down through the surface of this soil. Previous to this, August 3 to 6, while this same plot was bare, water had been applied over a period of 8.75 hours and only 5.88 inches had been absorbed. At the end of the last test on the bare soil, the rate at which water was entering the soil was 0.35 inch an hour, and the rate had been down during the previous test to 0.21 inch an hour. After the plot was again cultivated and covered with straw the rate of intake did not fall below 1.20 inches an hour during the 14 hours of application, August 8 to 10, 1938.

[4] It should be remembered that at the beginning of test 1 on August 3 this plot was spaded to a depth of 6 inches.

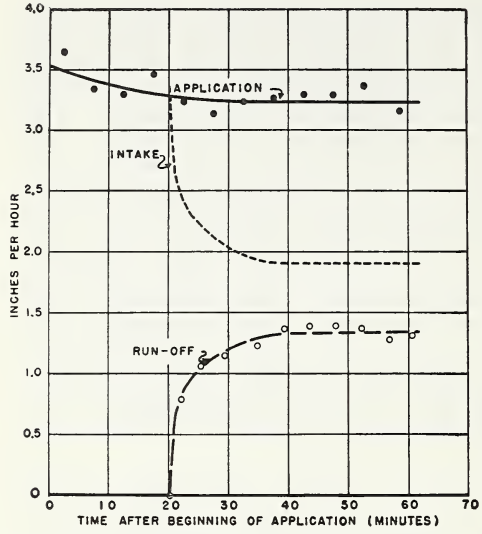

FIGURE 4.—Intake and run-off at location E, plot 2A, test 3, August 9. Plot 2A is plot 2 after it had been raked and covered with straw. Plot 2 had been previously cultivated to a depth of 6 inches. Test 1, August 8, and test 2, August 9, on plot 2A, gave no run-off.

PROLONGED APPLICATION ON STRAW-COVERED PLOT. (Location E, plot 4, tests 1–3.)

One attempt was made to determine the effect of a continuous and prolonged application of water to a straw-covered cultivated plot on this Marshall silt loam (heavy subsoil). Except for two stops to change nozzles and adjust equipment, the test was continued over a period of 22.5 hours. The results are shown in figure 6.

During the first 70 minutes there was no run-off even though the application was in excess of 5 inches an hour. The intake rate then dropped rapidly for about 3 hours and then more gradually, finally becoming nearly constant at

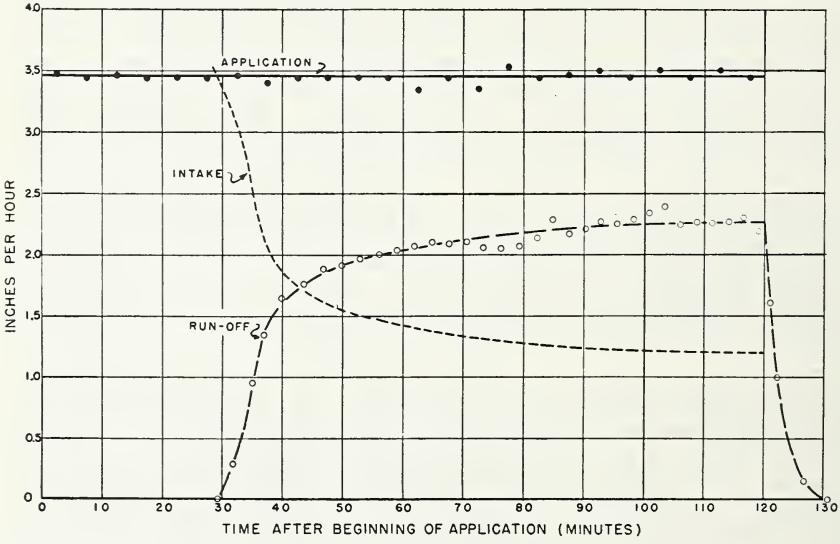

FIGURE 5.—Plot 2A, test 4, August 10. The run-off did not begin until water had been applied for nearly 30 minutes. The intake rate remained high throughout the period of this test.

0.5 inch an hour during the last 4 or 5 hours of the application.

During the 22.5 hours from the beginning to the end of application, 23.37 inches of water had passed into this soil. Of this amount about 68 percent was absorbed during the first one-third of the time. This again indicates the great importance of the absorption during the first part of a period of rainfall, during which time the curve for intake may be dropping rapidly.

Attention is again called to the fact that no provision was made in these tests to guard against lateral spread of water below and beyond the plot boundaries. Excavations showed that during long runs this spread on each side may be about half as wide as the plot, thus doubling the wetted area in the subsoil.

FINAL INTAKE RATES ON BARE AND STRAW-COVERED PLOTS

The foregoing data show that the range in rates of intake on this Marshall silt loam soil under different surface conditions was wide and that rates of intake differed at successive applications. Figure 7 indicates that the rate of intake of water became approximately constant on this Marshall silt loam at points ranging from 0.21 inch to 1.90 inches an hour. The amount of intake depended on the conditions under which the determinations were made.

Lancaster Sandy Loam

In the tests made on Lancaster sandy loam the surface treatments were similar to those on the Marshall silt loam. In some of these tests the bare cultivated soil was used; in others the cultivated soil was covered with straw at the rate of 2.5 tons per acre. Two tests were made on a plot from which the straw had been removed.

FINAL INTAKE RATES ON BARE AND STRAW-COVERED PLOTS AND ON PLOTS FROM WHICH STRAW HAD BEEN REMOVED

Figure 8 shows that for the Lancaster sandy loam the nearly constant intake rates recorded for the three treatments and for different runs ranged from about 0.32 inch to 1.36 inches per hour. These differences in the constant intake rates on this soil were obtained simply by altering the conditions under which the tests were made, as were corresponding differences on the Marshall silt loam.

It would seem to be significant not only that the intake rate on this sandy loam soil varied widely but also that the variation was over a strikingly similar but slightly narrower range than that recorded for the Marshall silt loam, which was radically different in texture and other physical and chemical properties and in profile characteristics. The curves showing the data in detail for the studies on Lancaster sandy loam are given in figures 9 to 18.

Bare Cultivated Plots. (Location J, plot 1, tests 1–3; figures 9–10.)

Figures 9 and 10 show the intake rates on the bare cultivated soil. During the first test, starting with the field soil in a fairly dry condition, water was applied at a rate of 1.82 inches per hour for 17

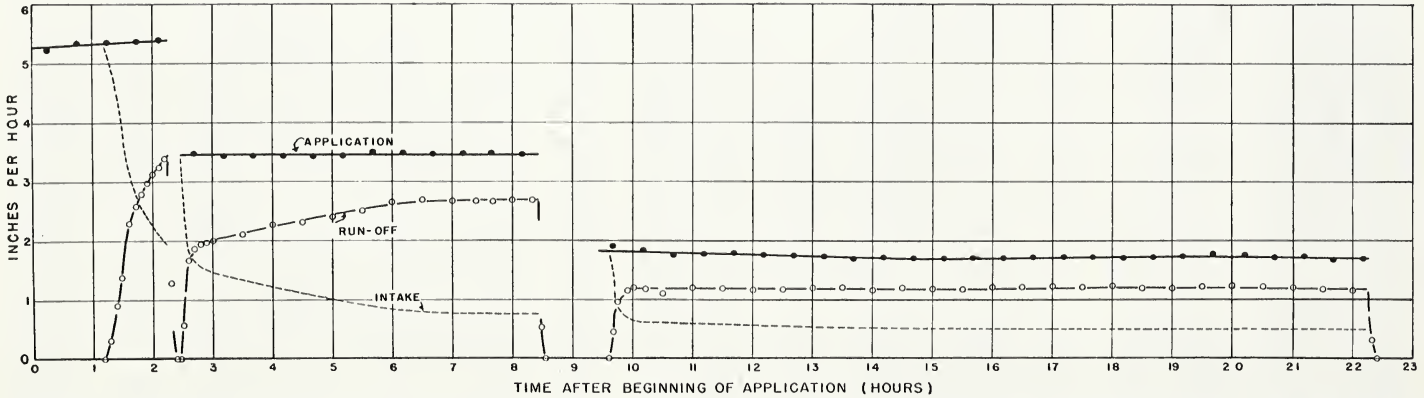

FIGURE 6.—Test on a straw-covered plot on Marshall silt loam that received water almost continuously for 22.5 hours. The total water absorbed during this period was 23.37 inches. The final rate of intake became practically constant at 0.5 inch per hour. It will be noted that even though the rate of application was changed twice the rate of intake is represented by a smooth curve of the same type shown for plots where a constant rate of application was maintained throughout, except for the increased intake immediately following a stop.

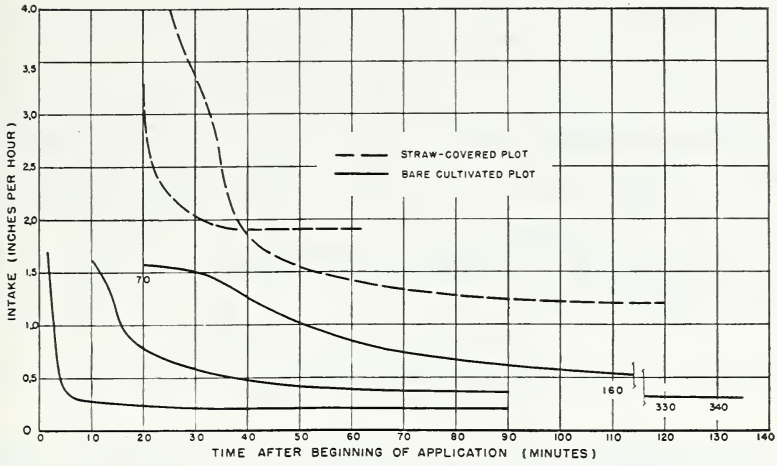

FIGURE 7.—Intake on Marshall silt loam, location E, plot 2, tests 1, 3, and 4, and plot 2A, tests 3 and 4. The nearly constant rates range from 0.21 to 1.90 inches per hour.

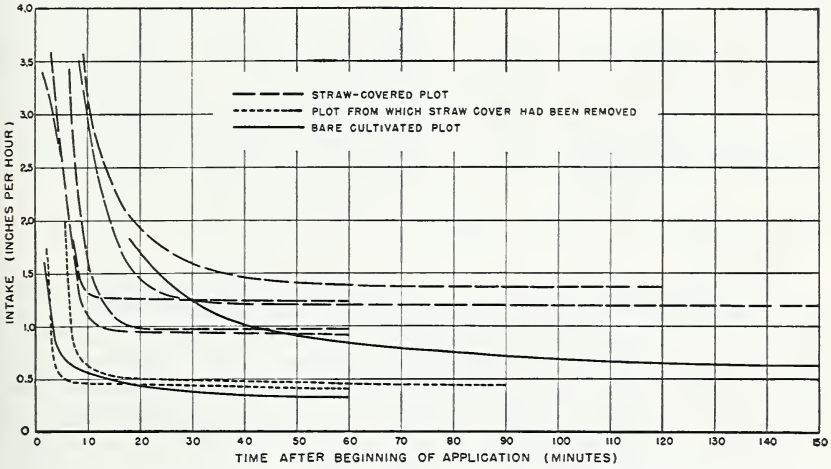
INTAKE (INCHES PER HOUR)
TIME AFTER BEGINNING OF APPLICATION (MINUTES)
STRAW-COVERED PLOT
PLOT FROM WHICH STRAW COVER HAD BEEN REMOVED
BARE CULTIVATED PLOT

FIGURE 8.—Infiltration on Lancaster sandy loam, location J; bare cultivated plots (tests 1 and 3) and straw-covered plots and plots from which straw had been removed (tests 2–8). The nearly constant rates range from 0.32 inch to 1.36 inches per hour.

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minutes before run-off began. The intake rate then dropped rapidly for about 25 minutes. During the remainder of the test it gradually de-

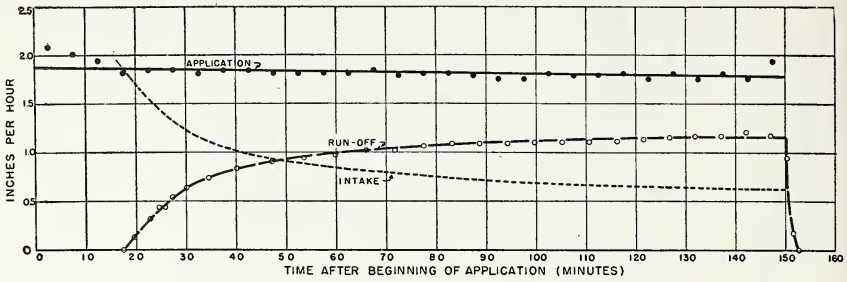

FIGURE 9.—Intake and run-off on Lancaster sandy loam, location J, plot 1, test 1. Cultivated bare soil, October 3.

clined, reaching a low point of about 0.62 inch after 2.5 hours. Immediately after the run-off stopped, the application was resumed and the intake rate continued without much change, becoming 0.60 inch after 70 minutes. The next day, October 4, another test was made, and after 1 hour the intake rate had been reduced to about 0.32 inch per hour (fig. 10). This was very similar to the results shown for the Marshall silt loam (fig. 3). It is notable, however, that this low constant rate of intake was reached in less time on the sandy loam than on the silt loam.

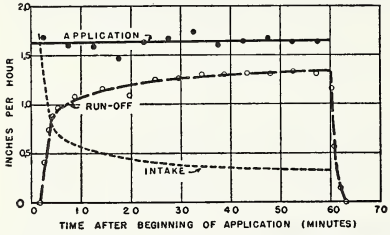

FIGURE 10.—Intake and run-off on Lancaster sandy loam, location J, plot 1, test 3, October 4.

STRAW-COVERED PLOTS. (Location J, plot 2, test 1–6; figures 11–16.)

The curves in figures 11 to 16 show the intake on Lancaster sandy loam that had been cultivated to a depth of 6 inches and then covered with straw. The first test, October 4, was carried on for 5.25 hours, with an application of 3.67 inches of water per hour. There was only 0.78 inch of run-off, and the infiltration rate did not become constant. It dropped to only 3.08 inches an hour at the end of the test (fig. 11).

On the next day during the second test the infiltration rate dropped rapidly for about 30 minutes, after which it remained practically constant for 2 hours at 1.20 inches an hour, as shown in figure 12. The application was stopped for 1 hour, and then test 3 was begun. After about 20 minutes the rate of intake became nearly constant and remained so for 40 minutes at slightly less than 1 inch an hour (fig. 13). The application was again stopped, and as soon as run-off ceased, more water was applied (test 4). The intake rate dropped to about 0.92 inch an hour (fig. 14).

The plot was then allowed to stand for 5 days, from October 5 to October 10. On that date water was applied for 2 hours (test 5), and after about 50 minutes the infiltration rate was found to become constant at approximately 1.4 inches an hour (fig. 15), a rate decidedly higher than that at the end of the previous application. As soon as run-off ceased, the application of water was resumed (test 6), and the intake rate dropped to about 1.24 inches per hour (fig. 16), or almost the same as the rate shown for test 2, 5 days before (fig. 12).

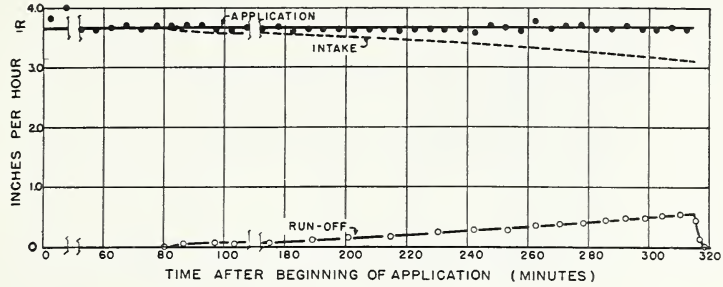

FIGURE 11.—Intake and run-off on Lancaster sandy loam, location J, plot 2 (covered with straw), test 1, October 4. During the first 5.25 hours the rate of intake did not become constant.

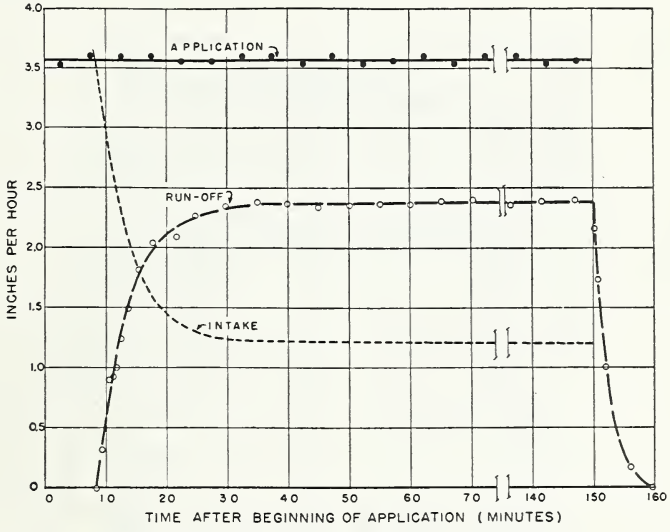

FIGURE 12.—Plot 2, test 2, October 5. The day after the first test was made the rate of intake became nearly constant at 1.20 inches per hour with an application in excess of 3.5 inches per hour.

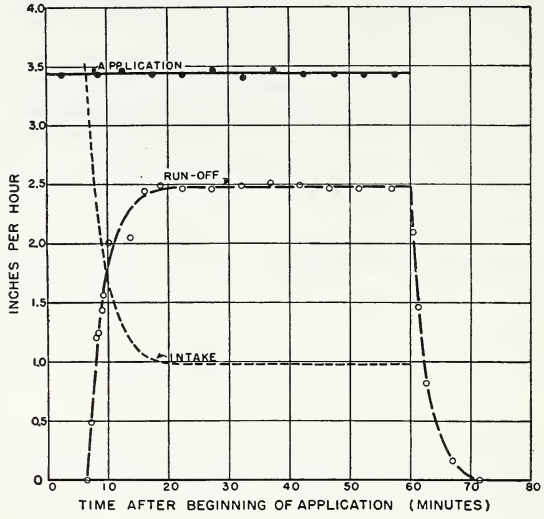

FIGURE 13.—Plot 2, test 3. Application was begun 1 hour after it had been stopped in the second test (fig. 12).

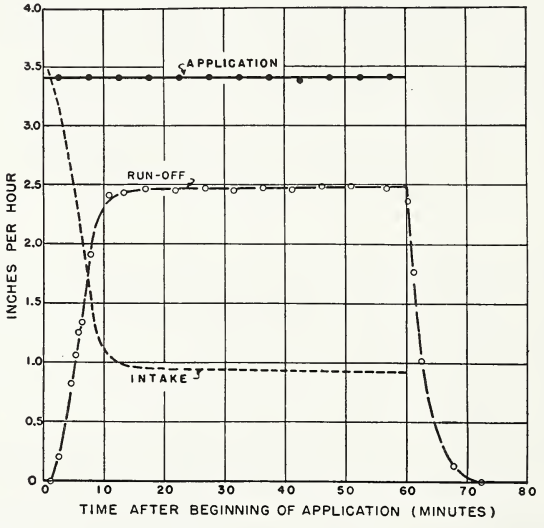

FIGURE 14.—Plot 2, test 4. Application was begun as soon as run-off ceased in test 3 (fig. 13).

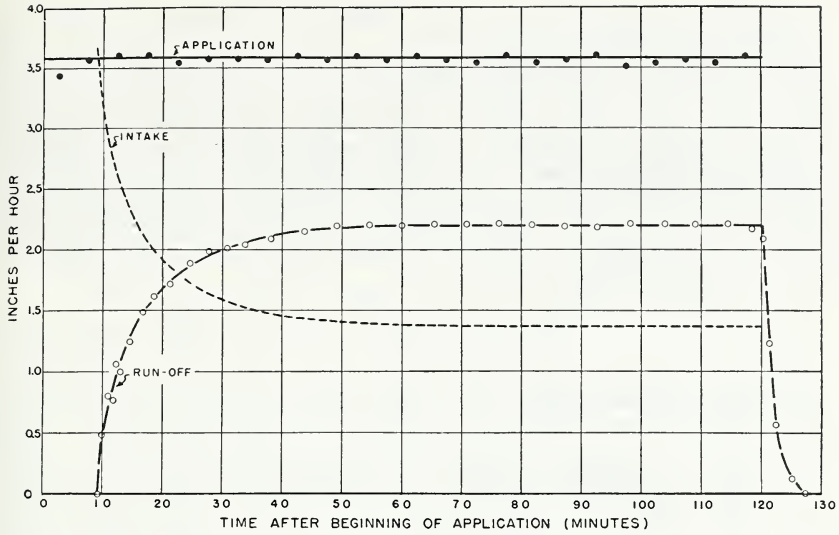

FIGURE 15.—Plot 2, test 5. After the fourth test had been made the plot stood for 5 days, when water was again applied. The constant intake rate was somewhat higher than the final for test 4 (fig. 14).

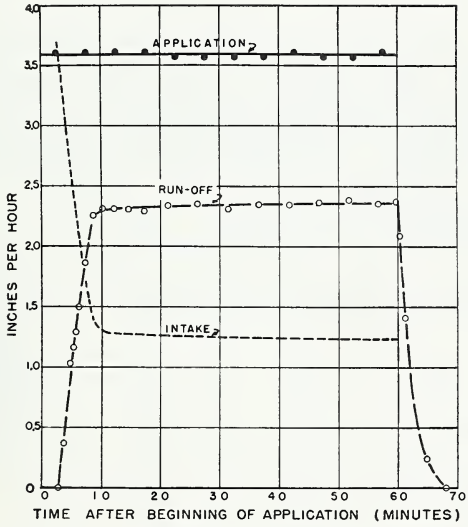

FIGURE 16.—Plot 2, test 6. As soon as run-off ceased in test 5 (fig. 15) water was again applied, and the rate of intake dropped to about 1.24 inches per hour.

Plots After Straw Cover Was Removed. (Location J, plot 2, tests 7–8; figures 17–18.)

After the application reported for plot 2 test 6 (fig. 16), the straw was removed from the surface of the plot, thus exposing the bare soil. On the same day, about 1.5 hours after the previous test, water was again applied to this plot. As the water hit the bare soil the intake rate dropped rapidly. In test 6, when the plot was covered with straw, the intake rate was 1.24 inches. When the surface had been made bare by removal of the straw (test 7), the rate dropped to 0.44 inch per hour, as shown in figure 17, and to 0.40 inch an hour (fig. 18) on a second run (test 8).

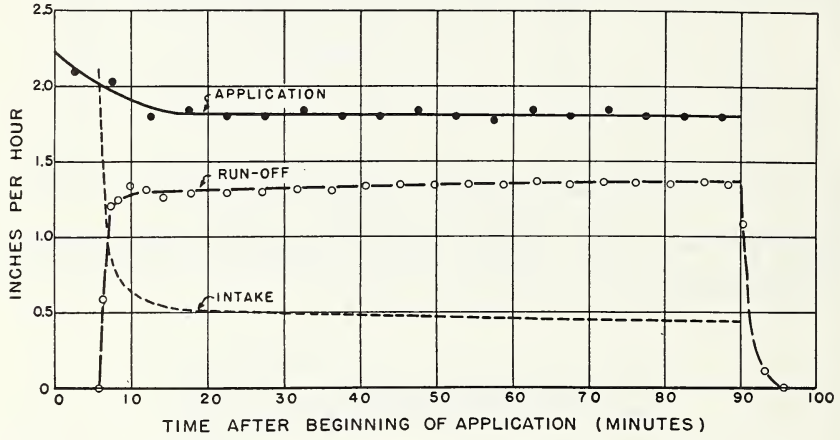

Figure 17.—First run after straw was removed from plot 2. After test 6 (figure 16) had been completed the straw was removed from the plot and water was sprinkled on the bare soil. The intake rate at the end of 1½ hours dropped to about 0.44 inch per hour.

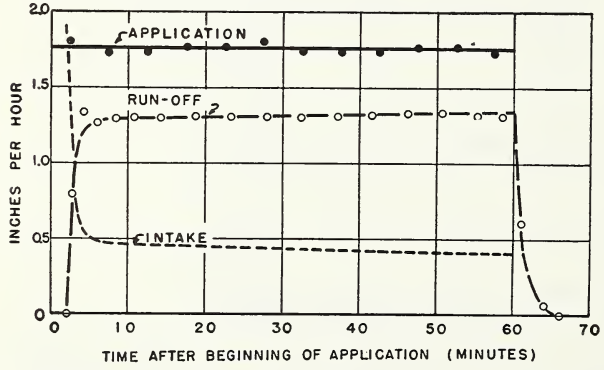

Figure 18.—Second run on bare soil (plot 2), made as soon as the run-off stopped in test 7, showed a further slight decrease in the rate of intake.

It should be noted that the drop in the intake was very rapid after the straw was removed. Within 20 minutes after the application began in test 7, or 15 minutes after run-off began, the intake rate had dropped to 0.5 inch an hour. This shows that when water fell on the bare soil, even though it was a sandy loam, the surface structure was quickly changed so that intake of water was greatly slowed down. In fact it appears that this sandy loam formed a compact layer at the surface more quickly than did the heavier Marshall silt loam.

Thus by removing the surface protection afforded by the straw and allowing the water to strike the bare ground, the soil was quickly changed from a condition that permitted rapid absorption to one in which the soil had a very low absorptive capacity. This took place with practically no change in the total "wetness" of the soil. It would seem to indicate that wetness in itself was not what caused the soil to have a very low intake rate. The surface cover or lack of it was of far greater importance, for the changes in soil structure at the immediate surface when the water fell on the soil apparently altered the intake rate more than the fact that the soil was wet.

INTAKE OF WATER ON GRASSED PLOTS

Location F (Plot 1: tests 1–5; figures 19–25)

A native sod on land in an old meadow on Marshall silt loam (heavy subsoil) only a short distance from the soil already discussed under location E, was used for testing the effect of grass on intake of water. The grass had been badly damaged during the drought years 1934–37. During the season of 1938, western wheatgrass (*Agropyron smithii*) had grown up in a rather sparse stand to a height of about 18 inches. Figures 19 to 23 illustrate changes in the intake rate during different tests.

Figure 19 illustrates the high intake rate and large total amount of water absorbed by grassland. During the first test 8.95 inches of water was absorbed in a 3-hour period. On the same day two more runs (tests 2 and 3) totaling 2.25 hours were made (figs. 20 and 21). During this time 2.19 inches of water was absorbed. This made a total of 11.14 inches that was absorbed during 5.25 hours.

On the next day a 2.0-hour run (test 4) and 3 days later a 1.5-hour run (test 5) were made. The results of these tests are shown in figures 22 and 23. The water absorbed at these two applications was 1.74 and 1.68 inches, respectively, but the final infiltration rate was reduced to 0.42 inch an hour. That is, even though the initial intake rate on the grassland was high, it dropped with continued applications of water to a point not far different from the rate on the bare cultivated soil shown in figure 3. The total amount of water absorbed by the grassland before this low intake rate was reached, however, was much greater than that absorbed by the bare soil, location E, plot 2, tests 1–4.

The effect of the vegetative parts of the plants together with the debris on the surface was tested by clipping the grass close to the ground, plot 2. After the grass was removed and the debris lightly swept off the plot, water was applied. During a 3-hour period (test 1) on September 7, an application of 9.68 inches of water was made, but only 2.09 inches was absorbed, whereas 8.95 inches had been absorbed during the same time on plot 1, where the grass and debris were undisturbed. The rate of absorption where the grass was clipped dropped very rapidly to about 0.63 inch an hour, as shown in figure 24. Figure 25 shows that another test the next day gave a still further drop in the intake. This would indicate that the surface cover of grass and debris is most important in maintaining for a considerable time a high intake of water on grassland. The results also indicate that high run-off may come from badly overgrazed pasture land and emphasize the importance of a good mat of grass and organic material on the surface of pasture or range as a safeguard against excessive run-off and flood flows from such lands.

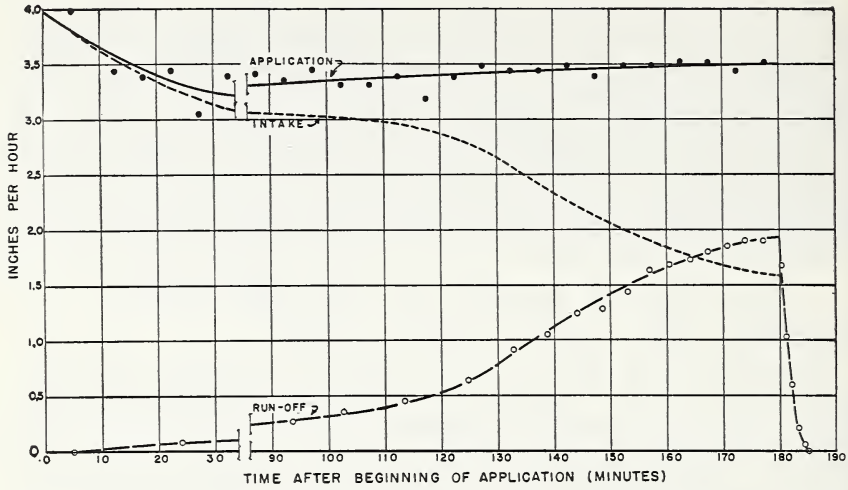

FIGURE 19.—Native prairie grassland, Marshall silt loam (heavy subsoil), location F, grass about 18 inches high. Plot 1, test 1, September 2.

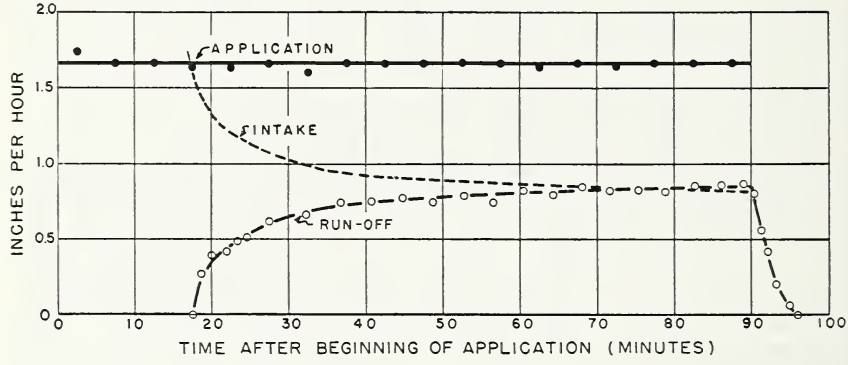

FIGURE 20.—Plot 1, test 2, immediately following test 1 (fig. 19).

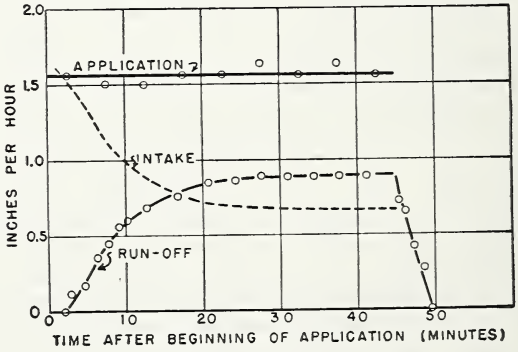

FIGURE 21.—Plot 1, test 3, immediately following test 2 (fig. 20).

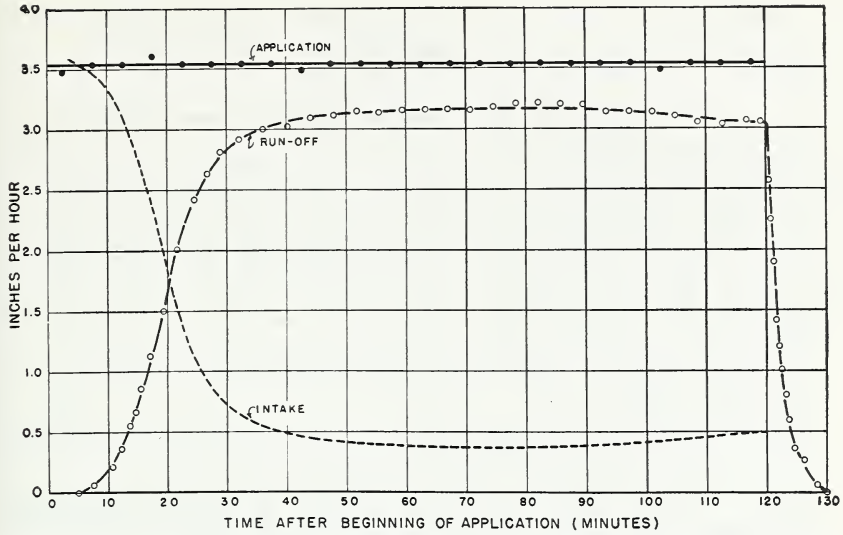

FIGURE 22.—Plot 1, test 4, September 3. This intake curve shows a slight increase at the end of 2 hours over the rate at the end of 1 hour. This did not often happen.

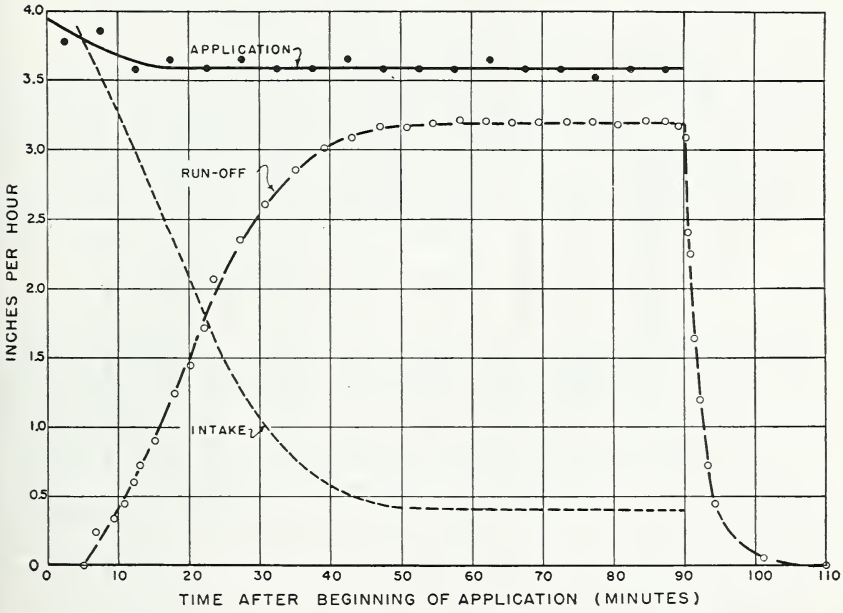

FIGURE 23.—Plot 1, test 5, September (fig. 22). The rate became constant at approximately the low point reached in test 4.

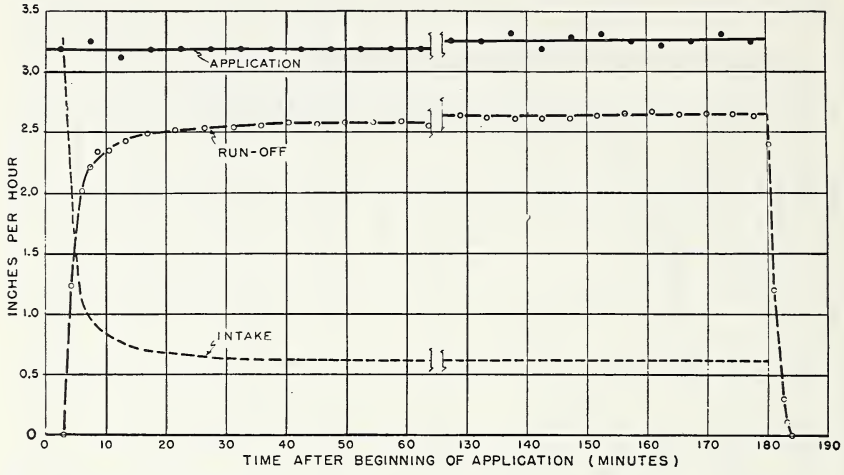

FIGURE 24.—Location F, plot 2, test 1, September 7. Native grass and surface debris removed from the prairie grassland. The intake was low in comparison with that on plot 1 where the grass was left standing (figure 19).

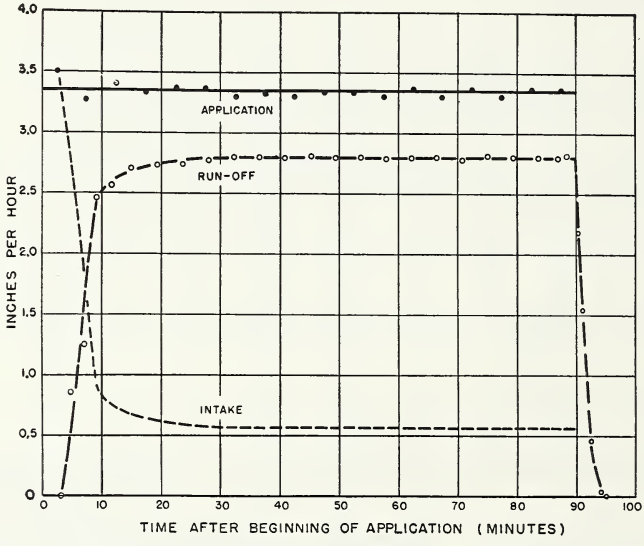

FIGURE 25.—Location F, plot 2, test 2. Second test on plot shown in figure 24, September 8.

DISCUSSION OF APPLICATION OF INFILTRATION STUDIES

Infiltration and Soil-Moisture Conservation

If land can be so managed that the intake rate will remain high for a considerable time after the rain starts, a much higher proportion of the total rainfall will be saved for the use of the crop.[5] Much of the water coming in small showers is lost through evaporation by being held in the dry soil at the surface. On the other hand, much of the water from the heavier rains is lost in run-off if the land is bare. By having the soil surface protected with residue, more of the water of the small rain may pass into the subsoil because there will be less dry soil at the surface to absorb the water. This is particularly true if the rains are close together. From a larger rain the run-off will be lessened by the mulch, and more water will be available for deep penetration below the range of rapid evaporation. Such water will remain in the soil for crop use, or in high-rainfall regions it would pass on down to replenish the ground-water.

In the great plains and other low-rainfall regions rains that are heavy enough to cause much run-off are relatively infrequent but these may offer the only opportunity during the season to get water deep enough into the subsoil to remain for the use of the next crop.

Infiltration and Erosion

As these tests indicate, crop residues on cultivated land, as well as the growing crop, increase infiltration and reduce run-off. With a reduction in run-off there is, of course, less soil loss. It must be remembered also that water running over a surface protected with some crop or residue carries less soil per unit of water than water coming from bare soil. The less soil in the run-off, the less will be the silt deposits in water courses, reservoirs, and streams.

Infiltration and Flood Control

Since cultivated land usually has a higher percentage of run-off than does land in forest or grass, a great part of the flood-control problem is concerned with the control of run-off from tilled soils. The increased rate and total amount of intake that occurred in these tests where the soil surface was protected with straw would suggest the possibility of increasing the intake with consequent reduction of run-off on cultivated land if the soil could be protected by crop residues when it is without a growing crop.

The possibility of using crop residues to increase infiltration on these extensive areas of land that must be kept in cultivation deserves the serious consideration of all those who are interested in the part played by infiltration rates and capacities on the magnitude of floods.

Methods of storing or disposing of run-off should also improve with a more accurate knowledge of the time when run-off may be expected to begin and the time when it may reach a maximum.

[5] Duley, F. L., and Russel, J. C. The use of crop residues for soil and moisture conservation. Amer. Soc. Agron. Jour. 31: 703–709, illus. 1939.

SUMMARY

The rate of intake of water by Marshall silt loam (heavy subsoil) and Lancaster sandy loam under a variety of conditions and times of application is presented as representative of infiltration data obtained by a study of 8 soils at 10 different locations in southeastern Nebraska, including open silt loams, silt loams, and clay loams with heavy subsoils, silty clay loams, and sandy loams.

The water was applied artificially to the plots by sprinkling. Since no provision was made to prevent lateral spread of water below the plot boundaries, the data are assumed to represent only the rate at which water penetrated the surface soil. It cannot be considered as showing quantitatively the amount that would be absorbed if the same amount of water should fall as rain. It was observed, however, that water readily penetrated all the subsoils studied.

The more important points brought out or confirmed by the study may be briefly stated as follows:

The curves representing the rate of intake of water when the land was bare showed a rapid drop after run-off began. The second application of water, if coming soon after the first, gave a further reduction in the rate of intake, and the rate became nearly constant within a short time.

In each of the soils tested the rate of intake of water was soon reduced to a low point if the soil was cultivated and bare. The reason for this low intake appeared to be the formation of a thin, dense, compact layer on the surface of the soil, which greatly and quickly reduced the rate of intake of water.

The curve representing the intake rate when the soil is protected by a mulch of straw shows a much more gradual drop and is maintained at a high level for a considerable time, and even then it does not drop so low as that for the bare soil. This appears to be due to the fact that the mulch greatly retards the formation of the compact layer on the surface.

In the soils tested the moisture content of the soil was of very much less importance than the condition of the surface. A wet soil was found to take in a large amount of water when the surface was kept open with a mulch. Wetness in itself did not necessarily mean a low intake rate. The rate was reduced much more rapidly on the bare soils even though they had absorbed only small amounts of water and were wet to only a few inches.

Grass on land permanently in sod had an effect very similar to that of a straw mulch in allowing a high rate of intake of water for a considerable time after the beginning of the application. When the grass and debris were removed from the surface the rate of intake fell much more rapidly. The final rate of intake for both the grassed plot and the plot from which the grass had been clipped was lower than that for the straw-covered plot.

After water was sprinkled on a plot for a time, usually 30 to 60 minutes on a cultivated plot and 2 to 8 hours on a straw-covered plot, the rate of intake of water became nearly constant. These constant

rates, however, varied within wide limits on any soil tested, the rate depending on whether the surface was protected or bare and on the length of time since the last application. The range over which these constant rates varied was strikingly similar for all the soils used in these studies. In these soils, therefore, it appears that a constant rate of intake was more closely associated with a certain set of surface conditions rather than with a specific soil.

Straw on the surface of the test plots was observed to reduce erosion greatly; even when there was a considerable amount of run-off, the water carried very little soil material.

APPENDIX

A sample of the complete field records is given in tables 1 to 4, which show rate of application and accumulated run-off at two plots on Marshall silt loam (heavy subsoil), location E, and two on Lancaster sandy loam, location J, all at Lincoln, Nebr. For each of these soils, the data are given for one plot that had been cultivated and left bare and one that had been cultivated and covered with straw.

Table 5 gives a concise review of each test at the 10 locations.

Detailed Field Data on Four Selected Tests

TABLE 1.—*Rate of application and accumulated run-off for the bare cultivated plot on Marshall silt loam (plot 2, test 4)*

Average rate of application of water in 10- and 5-minute intervals		Run-off accumulated at designated time after beginning of application			
Minutes	Inches per hour	Minutes and seconds	Surface inches	Minutes and seconds	Surface inches
0–10	1.75	0 00 [1]	0	58 38	0.80
10–20	1.62	10 00 [2]	0	61 01	.85
20–25	1.59	17 00	.035	63 26	.90
25–30	1.65	18 13	.05	65 49	.95
30–35	1.59	21 46	.10	68 15	1.00
35–40	1.72	25 00	.15	70 38	1.05
40–45	1.55	28 00	.20	73 03	1.10
45–50	1.62	30 51	.25	75 28	1.15
50–55	1.65	33 35	.30	77 50	1.20
55–60	1.59	36 16	.35	80 14	1.25
60–65	1.59	38 53	.40	82 35	1.30
65–70	1.72	41 25	.45	84 57	1.35
70–75	1.52	43 59	.50	87 16	1.40
75–80	1.66	46 29	.55	89 40	1.45
80–85	1.62	48 56	.60	90 00 [3]	1.458
85–90	1.59	51 24	.65	92 30 [4]	1.479
		53 49	.70		
0–90	1.63	56 14	.75		

[1] Application began. [2] Run-off began. [3] Application discontinued. [4] Run-off ceased.

TABLE 2.—*Rate of application and accumulated run-off for the plot on Marshall silt loam that was cultivated and covered with straw (plot 2, test 4)*

Average rate of application of water in 5- and 10- minute intervals		Run-off accumulated at designated time after beginning of application			
Minutes	Inches per hour	Minutes and seconds	Surface inches	Minutes and seconds	Surface inches
0–5	3.47	0 00 [1]	0	82 03	1.55
5–10	3.44	29 06 [2]	0	83 29	1.60
10–15	3.46	34 13	.025	84 48	1.65
15–20	3.44	35 48	.05	86 07	1.70
20–30	3.44	38 02	.10	87 31	1.75
30–35	3.46	39 55	.15	88 53	1.80
35–40	3.40	41 42	.20	90 15	1.85
40–45	3.44	43 25	.25	91 36	1.90
45–50	3.44	45 06	.30	92 56	1.95
50–55	3.44	46 47	.35	94 15	2.00
55–60	3.44	48 18	.40	95 35	2.05
60–65	3.34	49 53	.45	96 55	2.10
65–70	3.44	51 26	.50	98 13	2.15
70–75	3.40	52 58	.55	99 32	2.20
75–80	3.53	54 29	.60	100 50	2.25
80–85	3.44	56 00	.65	102 06	2.30
85–90	3.47	57 29	.70	103 24	2.35
90–95	3.50	58 57	.75	104 00	2.40
95–100	3.44	60 25	.80	106 01	2.45
100–105	3.50	61 51	.85	107 21	2.50
105–110	3.44	63 19	.90	108 41	2.55
110–115	3.50	64 44	.95	110 00	2.60
115–120	3.44	66 10	1.00	111 22	2.65
0–120	3.46	67 36	1.05	112 40	2.70
		69 03	1.10	114 00	2.75
		70 28	1.15	115 19	2.80
		71 54	1.20	116 31	2.85
		73 22	1.25	117 55	2.90
		74 50	1.30	119 14	2.95
		76 17	1.35	120 00 [3]	2.976
		77 96	1.40	120 34	3.00
		79 13	1.45	121 30	3.025
		80 40	1.50	123 00	3.05
				130 45 [4]	3.07

[1] Application began. [2] Run-off began. [3] Application discontinued. [4] Run-off ceased.

TABLE 3.—*Rate of application and accumulated run-off for the bare cultivated plot on Lancaster sandy loam (plot 1, test 1)*

Average rate of application of water in 5-minute intervals		Run-off accumulated at designated time after beginning of application			
Minutes	Inches per hour	Minutes and seconds	Surface inches	Minutes and seconds	Surface inches
0–5	2.08	0 00 [1]	0	107 55	1.35
5–10	2.01	17 20 [2]	0	110 39	1.40
10–15	1.94	21 55	.01	113 23	1.45
15–20	1.81	23 46	.02	116 05	1.50
20–25	1.84	25 09	.03	118 47	1.55
25–30	1.84	26 33	.04	121 28	1.60
30–35	1.81	27 40	.05	124 06	1.65
35–40	1.84	32 24	.10	126 43	1.70
40–45	1.84	36 29	.15	129 19	1.75
45–50	1.81	40 13	.20	131 54	1.80
50–55	1.81	43 44	.25	134 27	1.85
55–60	1.81	47 06	.30	137 04	1.90
60–65	1.81	50 24	.35	139 35	1.95
65–70	1.84	53 37	.40	142 05	2.00
70–75	1.78	56 46	.45	144 33	2.05
75–80	1.81	59 51	.50	147 04	2.10
80–85	1.81	62 57	.55	149 36	2.15
85–90	1.78	65 58	.60	150 00 [3]	2.156
90–95	1.75	68 51	.65	150 46	2.17
95–100	1.75	71 46	.70	152 31 [4]	2.175
100–105	1.81	74 44	.75		
105–110	1.78	77 34	.80		
110–115	1.78	80 22	.85		
115–120	1.81	83 07	.90		
120–125	1.75	85 54	.95		
125–130	1.81	88 41	1.00		
130–135	1.75	91 27	1.05		
135–140	1.81	94 13	1.10		
140–145	1.75	96 59	1.15		
145–150	1.94	99 42	1.20		
0–150	1.83	102 27	1.25		
		105 12	1.30		

[1] Application began. [2] Run-off began. [3] Application discontinued. [4] Run-off ceased.

TABLE 4.—*Rate of application and accumulated run-off for the plot on Lancaster sandy loam that was cultivated and covered with straw (plot 2, test 2)*

Average rate of application of water in 5-minute intervals		Run-off accumulated at designated time after beginning of application			
Minutes	Inches per hour	Minutes and seconds	Surface inches	Minutes and seconds	Surface inches
0–5	3.53	0 00 [1]	0	81 47	2.70
5–10	3.60	8 25 [2]	0	83 03	2.75
10–15	3.60	10 17	.01	84 18	2.80
15–20	3.60	10 57	.02	85 34	2.85
20–25	3.56	11 36	.03	86 50	2.90
25–30	3.56	12 12	.04	88 06	2.95
30–35	3.60	12 41	.05	89 26	3.00
35–40	3.60	14 42	.10	90 36	3.05
40–45	3.53	16 21	.15	91 53	3.10
45–50	3.60	17 52	.20	93 09	3.15
50–55	3.53	19 18	.25	94 26	3.20
55–60	3.56	20 41	.30	95 43	3.25
60–65	3.60	22 01	.35	96 59	3.30
65–70	3.53	23 22	.40	98 14	3.35
70–75	3.60	24 41	.45	99 31	3.40
75–80	3.53	26 00	.50	100 46	3.45
80–85	3.56	27 18	.55	102 03	3.50
85–90	3.60	28 35	.60	103 19	3.55
90–95	3.56	29 52	.65	104 36	3.60
95–100	3.56	31 08	.70	105 53	3.65
100–105	3.60	32 24	.75	107 10	3.70
105–110	3.53	33 40	.80	108 26	3.75
110–115	3.56	34 56	.85	109 44	3.80
115–120	3.56	36 11	.90	111 00	3.85
120–125	3.53	37 26	.95	112 17	3.90
125–130	3.60	38 41	1.00	113 33	3.95
130–135	3.53	39 59	1.05	114 50	4.00
135–140	3.60	41 14	1.10	116 05	4.05
140–145	3.53	42 30	1.15	117 22	4.10
145–150	3.56	43 46	1.20	118 38	4.15
		45 02	1.25	119 56	4.20
0–150	3.57	46 21	1.30	121 13	4.25
		47 38	1.35	122 31	4.30
		48 55	1.40	123 48	4.35
		50 11	1.45	125 05	4.40
		51 27	1.50	126 21	4.45
		52 43	1.55	127 38	4.50
		53 58	1.60	128 55	4.55
		55 15	1.65	130 12	4.60
		56 30	1.70	131 29	4.65
		57 47	1.75	132 46	4.70
		59 04	1.80	134 02	4.75
		60 20	1.85	135 19	4.80
		61 36	1.90	136 35	4.85
		62 52	1.95	137 51	4.90
		64 08	2.00	139 07	4.95
		65 23	2.05	140 23	5.00
		66 39	2.10	141 36	5.05
		67 55	2.15	142 52	5.10
		69 10	2.20	144 08	5.15
		70 25	2.25	145 23	5.20
		71 40	2.30	146 38	5.25
		72 55	2.35	147 54	5.30
		74 10	2.40	149 09	5.35
		75 25	2.45	150 00 [3]	5.385
		76 42	2.50	150 25	5.40
		77 58	2.55	151 17	5.425
		79 15	2.60	152 47	5.45
		80 31	2.65	159 44 [4]	5.471

[1] Application began. [2] Run-off began. [3] Application discontinued [4] Run-off ceased.

Summary Data for Plots at the 10 Locations

Table 5.—*Summary of infiltration data obtained with artificial applications of water on plots at 10 locations in southeastern Nebraska, 1938*

LOCATION A, LINCOLN, NEBR., MARSHALL SILT LOAM (HEAVY SUBSOIL)

Month and day of test	Treatment of plot	Slope	Plot	Test	Time since previous application		Application			Disposition of total amount of water		Final rate of intake	Erosion on each plot
							Duration	Average rate	Total amount of water	Run-off	Intake		
		Pct.	*No.*	*No.*	*Days*	*Hr.*	*Hr.*	*In. per hr.*	*In.*	*In.*	*In.*	*In. per hr.*	*Lb.*
Apr. 20	Cultivated, bare	6	1	1	----	------	2.50	1.48	3.70	1.23	2.47	0.79	8.03
21		6	1	2	1	------	1.50	1.31	1.96	1.57	.39	.14	12.70
22		6	2	1	----	------	1.50	3.40	5.10	4.23	.87	.28	76.07
26		6	2	2	4	------	1.50	2.91	4.36	4.17	.19	.13	73.12
28		4	3	1	----	------	1.50	3.26	4.89	3.90	.99	.38	55.13
29		4	3	2	1	------	1.50	3.05	4.57	4.12	.45	.25	81.11
28		4	4	1	----	------	2.25	.86	1.93	.95	.98	.22	2.29
29		4	4	2	1	------	1.50	1.05	1.57	1.05	.52	.22	3.93
26		2	5	1	----	------	1.50	1.38	2.07	1.23	.84	.38	4.42
27		2	5	2	1	------	1.50	1.17	1.75	1.42	.33	.17	3.59
22		2	6	1	----	------	1.75	3.18	5.56	4.28	1.28	.40	17.17
25		2	6	2	3	------	1.50	3.22	4.83	4.52	.31	.12	20.43
15	Not cultivated, bare	5	7	1	----	------	2.46	3.47	8.54	7.26	1.28	.44	117.47
18		5	7	2	3	------	1.50	3.58	5.37	5.15	.22	.11	45.99
14		5	8	1	----	------	2.50	1.49	3.72	1.24	2.48	.83	8.59
19		5	8	2	5	------	1.50	1.37	2.06	1.48	.58	.26	4.54

LOCATION B, LINCOLN, NEBR., BUTLER SILT LOAM

May 10	Cultivated, bare	6	1	1	----	------	1.50	3.01	4.50	3.24	1.26	0.35	45.80
11		6	1	2	1	------	1.50	2.91	4.36	3.78	.58	.24	67.61
10		6	2	1	----	------	2.22	1.24	2.75	1.02	1.73	.36	3.23
11		6	2	2	1	------	1.50	1.51	2.26	1.65	.61	.22	30.79
17		4	3	1	----	------	2.00	1.50	3.00	1.52	1.48	.52	5.12
18		4	3	2	1	------	1.50	1.31	1.96	1.34	.62	.17	5.09
18		4	4	1	----	------	1.64	3.15	5.17	.92	4.25	1.64	2.70
19		4	4	2	1	------	1.50	2.99	4.48	2.77	1.71	.91	11.23
13		2	5	1	----	------	2.00	1.50	3.00	1.11	1.89	.49	2.34
17		2	5	2	4	------	1.50	1.38	2.07	1.43	.64	.27	3.61
13		2	6	1	----	------	1.50	3.10	4.65	3.71	.94	.24	14.65
16		2	6	2	3	------	1.50	2.96	4.44	4.03	.41	.03	17.32
19	Corn stubble	7	7	1	----	------	1.50	3.01	4.51	4.03	.48	.14	232.42
20		7	7	2	1	------	1.50	2.99	4.48	4.31	.17	.05	123.28
19		7	8	1	----	------	1.50	1.53	2.30	1.62	.68	.26	54.64
20		7	8	2	1	------	1.50	1.41	2.12	1.94	.18	.09	46.99

TABLE 5.—*Summary of infiltration data obtained with artificial applications of water on plots at 10 locations in southeastern Nebraska, 1938*—Continued

LOCATION C, RALSTON, NEBR., MARSHALL SILT LOAM (ERODED PHASE)

Month and day of test	Treatment of plot	Slope	Plot	Test	Time since previous application		Application			Disposition of total amount of water		Final rate of intake	Erosion on each plot
							Duration	Average rate	Total amount of water	Run-off	Intake		
		Pct.	*No.*	*No.*	*Days*	*Hr.*	*Hr.*	*In. per hr.*	*In.*	*In.*	*In.*	*In. per hr.*	*Lb.*
May 25	Cultivated, bare	6	1	1			1.50	1.55	2.32	1.38	0.94	0.35	8.94
26		6	1	2	1		1.50	1.51	2.26	1.88	.38	.15	37.06
25		6	2	1			1.50	3.10	4.65	3.72	.93	.34	114.26
26		6	2	2	1		1.50	2.84	4.26	3.85	.41	.20	97.51
27		4	3	1			1.50	1.51	2.26	1.27	.99	.31	3.22
28		4	3	2	1		1.50	1.59	2.38	1.91	.47	.14	8.07
27		4	4	1			1.50	2.96	4.44	3.53	.91	.25	26.62
28		4	4	2	1		1.50	2.98	4.47	4.32	.15	.06	41.83
June 1		2	5	1			1.50	1.44	2.16	1.01	1.15	.36	1.95
2		2	5	2	1		1.50	1.48	2.22	1.74	.48	.14	5.53
1		2	6	1			1.50	3.13	4.69	3.12	1.57	.53	8.70
2		2	6	2	1		1.50	3.04	4.56	3.87	.69	.26	12.67
3		10	7	1			1.50	1.47	2.20	1.29	.91	.28	16.22
4		10	7	2	1		1.50	1.39	2.08	1.73	.35	.12	51.02
3		10	8	1			1.50	3.01	4.51	3.84	.67	.29	150.57
4		10	8	2	1		1.50	2.81	4.21	4.08	.13	.05	130.53
6	Disked	11	9	1			2.50	1.43	3.58	.97	2.61	.77	21.74
7		11	9	2	1		1.50	1.39	2.08	1.58	.50	.13	53.93
6		11	10	1			1.50	3.06	4.59	2.75	1.84	.60	152.40
7		11	10	2	1		1.50	2.99	4.48	4.04	.44	.28	161.90
8	Alfalfa, 12 inches	9	11	1			4.25	1.48	6.29	1.31	4.98	.94	.90
9		9	11	2	1		2.00	1.50	3.00	1.10	1.90	.83	.68
9		9	12	1			2.00	2.78	5.56	2.75	2.81	.74	3.18
10		9	12	2	1		1.50	3.08	4.62	3.03	1.59	.71	1.67
13	Oats-Barley, 24 inches	10	13	1			1.50	3.10	4.65	2.36	2.29	1.07	7.37
14		10	13	2	1		1.50	2.98	4.47	3.36	1.11	.58	9.98
13		10	14	1			2.00	1.43	2.86	.88	1.98	.78	1.69
14		10	14	2	1		1.50	1.49	2.23	1.37	.86	.42	2.04

LOCATION D, BLAIR, NEBR., KNOX SILT LOAM

June 17	Cultivated, bare	6	1	1			1.50	3.21	4.81	3.80	1.01	0.25	126.66
18		6	1	2	1		1.50	3.13	4.69	4.22	.47	.22	165.66
17		6	2	1			1.50	1.45	2.17	1.38	.79	.26	13.47
18		6	2	2	1		1.50	1.50	2.25	1.77	.48	.12	32.15
20		2	3	1			1.50	3.08	4.62	3.21	1.41	.52	21.13
21		2	3	2	1		1.50	3.15	4.73	3.88	.85	.33	42.70
20		2	4	1			2.00	1.50	3.00	1.61	1.39	.48	6.63
21		2	4	2	1		1.50	1.45	2.18	1.55	.63	.21	7.45
23		4	5	1			1.50	2.93	4.40	3.45	.95	.60	68.17
24		4	5	2	1		1.50	2.88	4.32	3.78	.54	.26	109.72
23		4	6	1			1.50	1.54	2.31	1.33	.98	.36	17.49
24		4	6	2	1		1.50	1.43	2.15	1.64	.51	.22	24.09
27		10	7	1			1.50	2.93	4.40	3.37	1.03	.50	192.54
28		10	7	2	1		1.50	2.98	4.47	4.04	.43	.26	213.07
27		10	8	1			1.50	1.56	2.34	1.36	.98	.42	55.04
28		10	8	2	1		1.50	1.42	2.13	1.71	.42	.21	61.30
29		.7	9	1			2.00	3.10	6.20	4.14	2.06	.67	14.26
30		.7	9	2	1		1.50	3.01	4.52	3.67	.85	.26	10.08
July 14		.8	10	1			3.50	1.49	5.22	2.04	3.18	.63	3.95
15		.8	10	2	1		3.00	1.50	4.50	2.98	1.52	.35	6.87
15		.8	10	3		0.58	.50	1.52	.76	.52	.24	.34	1.39
15		.8	10	4		.33	.50	1.55	.77	.54	.23	.34	1.53
16		.8	10	5	1		1.00	1.51	1.51	.99	.52	.27	1.87
16		.8	10	6		.50	.75	1.45	1.09	.88	.21	.25	1.78
18		.8	10	7	2		1.75	1.54	2.70	1.76	.94	.25	8.48
18		.8	10	8		.50	.50	1.52	.76	.57	.19	.22	2.31
19		.8	10	9	1		.75	1.53	1.15	.79	.36	.20	2.23
19		.8	10	10		.20	.50	1.43	.72	.58	.14	.16	1.49
20	Plot 5 re-spaded and covered with straw.	4	5A	1			7.25	1.54	11.13	.00	11.13	1.54	.00
21		4	5A	2	1		5.27	1.63	8.59	.85	7.74	[1] 1.47	.55
21		4	5A	3		.33	1.28	3.20	4.10	1.35	2.79	2.09	.93
22		4	5A	4	1		1.33	1.65	2.20	.32	1.88	1.20	.18
22		4	5A	5		.75	.76	3.24	2.46	1.42	1.04	1.15	.86

See footnotes at end of table.

TABLE 5.—*Summary of infiltration data obtained with artificial applications of water on plots at 10 locations in southeastern Nebraska, 1938*—Continued

LOCATION E, LINCOLN, NEBR., MARSHALL SILT LOAM (HEAVY SUBSOIL)

Month and day of test	Treatment of plot	Slope	Plot	Test	Time since previous application		Application			Disposition of total amount of water		Final rate of intake	Erosion on each plot
							Duration	Average rate	Total amount of water	Run-off	Intake		
		Pct.	*No.*	*No.*	*Days*	*Hr.*	*Hr.*	*In. per hr.*	*In.*	*In.*	*In.*	*In. per hr.*	*Lb.*
July 27	Combine wheat stubble.	4	1	1	----	----	4.25	1.46	6.21	0.00	6.21	1.46	0.00
28		4	1	2	1	----	6.50	1.50	9.75	.42	9.33	1.43	.32
29		4	1	3	1	----	4.50	1.43	6.44	1.65	4.79	.99	1.22
29		4	1	4	----	1.00	1.00	3.15	3.15	2.04	1.11	.72	1.44
30		4	1	5	1	----	1.75	1.55	2.71	1.04	1.67	.69	.73
30		4	1	6	----	.50	1.00	3.38	3.38	2.43	.95	.68	1.95
Aug. 1		4	1	7	2	----	2.08	1.55	3.22	1.02	2.20	.83	.77
1		4	1	8	----	.50	1.00	3.25	3.25	2.28	.97	.56	2.82
5		4	1	9	4	----	2.50	1.57	3.93	1.01	2.92	.92	.95
5		4	1	10	----	.20	1.00	3.19	3.19	2.12	1.07	.81	2.19
3	Cultivated, bare	4	2	1	----	----	5.75	1.59	9.14	4.59	4.55	.31	17.34
4		4	2	[2] 2	----	----	----	----	----	----	----	----	----
4		4	2	3	----	1.00	1.50	1.60	2.40	2.04	.36	.21	7.50
6		4	2	4	2	----	1.50	1.63	2.45	1.48	.97	.35	6.26
8	Plot 2 cultivated and covered with straw.	4	2A	1	2	----	6.00	1.68	10.08	.00	10.08	1.68	.00
9		4	2A	2	1	----	5.00	1.60	8.00	.00	8.00	1.60	.00
9		4	2A	3	----	.25	1.03	3.29	3.39	.86	2.53	1.90	[3]
10		4	2A	4	1	----	2.00	3.46	6.92	3.07	3.85	1.20	3.14
10	Cultivated, burlap cover	4	3	1	----	----	4.50	1.69	7.61	.00	7.61	1.69	.00
12		4	3	2	2	----	6.50	1.68	10.94	.00	10.94	1.68	.00
12		4	3	3	----	.25	1.00	3.74	3.74	1.33	2.41	1.94	[3] .00
13		4	3	4	1	----	2.00	2.92	5.85	2.39	3.46	1.14	[3] .00
15		4	3	5	2	----	1.73	3.06	5.30	2.20	3.10	1.21	[4] .00
16		4	3	6	1	----	1.50	2.86	4.29	1.65	2.64	1.08	[3] .00
17	Cultivated and covered with straw.	4	4	1	----	----	2.25	5.35	12.05	2.47	9.58	2.05	[3]
17		4	4	2	----	.16	6.00	3.46	20.75	14.44	6.31	.77	[3]
17		4	4	3	----	1.00	13.00	1.74	22.62	15.14	7.48	.48	[3]
20		4	4	4	3	----	1.63	3.87	6.31	2.52	3.79	1.52	[3]
22	Stubble burned	4	5	1	----	----	5.00	1.62	8.10	.65	7.45	1.28	.94
23		4	5	2	1	----	3.00	1.63	4.89	2.33	2.56	.66	3.03
23		4	5	3	----	1.00	3.50	1.63	5.70	3.61	2.09	.54	3.90
24		4	5	4	1	----	1.50	1.69	2.54	1.32	1.22	.61	1.85
24		4	5	5	----	.20	1.00	3.31	3.31	2.65	.66	.48	2.86
26	Cultivated, bare	15	6	1	----	----	7.00	1.58	11.05	1.23	9.82	1.02	1.17
26		15	6	2	----	.30	1.00	1.53	1.53	.44	1.09	.80	.41
29	Spaded 6 inches, burlap cover.	6	7	1	----	----	8.00	1.61	12.85	.00	12.85	1.61	.00
30		6	7	2	1	----	3.50	3.48	12.20	1.42	10.78	2.71	[3]
30		6	7	3	----	1.00	.75	3.26	2.44	.71	1.73	1.78	[3]
30		6	7	4	----	.06	.50	3.22	1.61	.77	.84	1.48	[3]

LOCATION F, LINCOLN, NEBR., MARSHALL SILT LOAM (HEAVY SUBSOIL)

Sept. 2	Sod, grass 18 inches	4	1	1	----	----	3.00	3.57	10.70	1.75	8.95	1.63	1.30
2		4	1	2	----	0.50	1.50	1.67	2.50	.91	1.59	.82	.61
2		4	1	3	----	.10	.75	1.56	1.17	.57	.60	.67	[5]
3		4	1	4	1	----	2.00	3.54	7.09	5.35	1.74	.48	[5]
6		4	1	5	3	----	1.50	3.63	5.45	3.77	1.68	.42	[5]
6	Sod, grass cut ¾ inch high.	4	1	6	----	.75	1.25	3.34	4.17	3.68	.49	.28	3.20
9	Sod, grass cut ¾ inch high.[6]	4	1	7	3	----	3.00	3.09	9.26	6.56	2.70	.34	[5]
13		4	1	8	4	----	2.00	3.02	6.04	4.43	1.61	.31	[5]
7	Grass and debris off	4	2	1	----	----	3.00	3.23	9.68	7.59	2.09	.63	20.29
8	Surface ruffed with rake.	4	2	2	1	----	1.50	3.35	5.03	3.96	1.07	.57	[5]
8	Same plot covered with straw.	4	2	3	----	1.00	3.00	3.22	9.67	6.79	2.88	1.01	[5]
9		4	2	4	1	----	1.75	3.14	5.50	4.03	1.47	.60	[5]
13	Sod—natural cover [7]	10	3	1	----	----	3.00	3.47	10.42	2.55	7.87	1.49	[5]
14		10	3	2	1	----	2.50	3.48	8.70	6.30	2.40	.59	[5]
14		10	3	3	----	.14	1.00	3.51	3.51	2.88	.63	.52	[5]
14		10	3	4	----	.15	1.00	3.42	3.42	2.81	.61	.48	[5]

See footnotes at end of table.

TABLE 5.—*Summary of infiltration data obtained with artificial applications of water on plots at 10 locations in southeastern Nebraska, 1938*—Continued

LOCATION G, LINCOLN, NEBR., BUTLER SILTY CLAY LOAM

Month and day of test	Treatment of plot	Slope	Plot	Test	Time since previous application		Application: Duration	Application: Average rate	Application: Total amount of water	Disposition of total amount of water: Run-off	Disposition of total amount of water: Intake	Final rate of intake	Erosion on each plot
		Pct.	*No.*	*No.*	*Days*	*Hr.*	*Hr.*	*In. per hr.*	*In.*	*In.*	*In.*	*In. per hr.*	*Lb.*
Sept. 19	Cultivated and covered with straw.	4	1	1	-----	------	6.00	2.98	17.87	5.09	12.78	1.28	(8)
20		4	1	2	1	------	3.00	2.95	8.85	6.19	2.66	.50	------
28		4	1	3	8	------	3.50	3.18	11.13	5.76	5.37	1.06	------
28		4	1	4	-----	0.14	1.00	3.27	3.27	2.21	1.06	.89	------
Oct. 13		4	1	5	-----	------	4.50	3.59	16.14	8.99	7.15	1.12	------
13		4	1	6	-----	.17	1.00	3.23	3.23	2.10	1.13	.96	------
21	Cultivated, bare	4	2	1	-----	------	2.00	1.76	3.52	2.11	1.41	.30	(5)
21		4	2	2	-----	.16	1.00	1.79	1.79	1.54	.25	.20	(5)
21		4	2	3	-----	.07	1.00	1.74	1.74	1.57	.17	.17	(5)
22		4	2	4	1	------	1.50	1.86	2.79	2.12	.67	.16	12.41
22		4	2	5	-----	.05	1.50	1.75	2.63	2.39	.24	.15	17.41

LOCATION H, LINCOLN, NEBR., PAWNEE CLAY LOAM

Sept. 23	Cultivated, bare	4	1	1	-----	------	4.00	1.60	6.40	2.81	3.59	0.50	(9)
24		4	1	2	1	------	2.00	1.52	3.04	2.12	.92	.33	4.87
24		4	1	3	-----	0.08	1.00	1.49	1.49	1.15	.34	.29	3.12
26	Cultivated and covered with straw.	4	2	1	-----	------	4.75	2.88	13.65	.46	13.19	(10)	(8)
26		4	2	2	-----	.25	1.00	3.52	3.52	1.47	2.05	1.71	(8)
26		4	2	3	-----	.10	1.00	3.56	3.56	2.08	1.48	1.28	(8)
27		4	2	4	1	------	2.00	3.42	6.84	4.50	2.34	.56	(8)
27		4	2	5	-----	.25	1.00	3.76	3.76	3.16	.60	.50	(8)
27		4	2	6	-----	.23	.83	3.58	2.98	2.48	.50	.48	(8)
Oct. 11		4	2	7	14	------	4.50	3.31	14.88	8.29	6.59	.68	(8)
11		4	2	8	-----	.33	1.00	3.23	3.23	2.48	.75	.56	(8)

LOCATION I, LINCOLN, NEBR., DICKINSON SANDY LOAM

Sept. 29	Cultivated, bare	4	1	1	-----	------	2.00	1.85	3.70	2.13	1.57	0.40	6.45
29		4	1	2	-----	0.05	1.00	1.70	1.70	1.38	.32	.31	3.25
30		4	1	3	1	------	1.00	1.61	1.61	1.26	.35	.24	3.30
30	Cultivated and covered with straw.	4	2	1	-----	------	3.50	3.00	10.49	1.90	8.59	1.70	(8)
Oct. 1		4	2	2	1	------	2.00	3.28	6.57	4.61	1.96	.56	(8)
1		4	2	3	-----	.33	1.00	3.23	3.23	2.57	.66	.48	(8)

LOCATION J, LINCOLN, NEBR., LANCASTER SANDY LOAM

Oct. 3	Cultivated, bare	4	1	1	-----	------	2.50	1.82	4.55	2.18	2.37	0.62	6.75
3		4	1	2	-----	0.04	1.17	1.59	1.85	1.25	.60	.60	2.40
4		4	1	3	1	------	1.00	1.63	1.63	1.18	.45	.32	2.19
4	Cultivated and covered with straw.	4	2	1	-----	------	5.25	3.67	19.25	.78	18.47	3.08	(5)
5		4	2	2	1	------	2.50	3.57	8.93	5.47	3.46	1.20	(5)
5		4	2	3	-----	1.00	1.00	3.44	3.44	2.19	1.25	.98	(5)
5		4	2	4	-----	.20	1.00	3.41	3.41	2.33	1.08	.92	(5)
10		4	2	5	5	------	2.00	3.58	7.16	3.87	3.29	1.36	(5)
10		4	2	6	-----	.12	1.00	3.59	3.59	2.20	1.39	1.24	(5)
10	Straw removed before tests.	4	2	7	-----	1.42	1.50	1.84	2.76	1.88	.88	.44	(5)
10		4	2	8	-----	.10	1.00	1.76	1.76	1.28	.48	.40	(5)

[1] Rate probably too low, since the application was only slightly above this. Next run shows higher intake.
[2] Results lost on account of rain.
[3] Water clear; no erosion samples taken.
[4] Water clear; no erosion samples taken. 2.33-inch rain since last test.
[5] Erosion not determined.
[6] Straw applied during test 7.
[7] Mixed grass—mainly a little bluestem.
[8] Run-off water practically clear; no erosion samples taken.
[9] No erosion samples taken.
[10] Stopped on account of mechanical trouble.

Soil Descriptions

LOCATION A, AGRONOMY FARM, 3 MILES NORTHEAST OF LINCOLN, NEBR.

Marshall silt loam (heavy subsoil)

The surface of the Marshall silt loam (heavy subsoil) is a very dark-brown friable silt loam to a silty clay loam to a depth of 8 inches and is well supplied with organic matter. At this depth it changes to a dark-brown clay loam with angular structure particles. At 12 inches the soil becomes a lighter tobacco brown, and it is tough plastic clay from 15 to 24 inches. The third foot is still of a lighter color but is a heavy clay loam with cubical structure. Between 4 and 6 feet the soil becomes gradually more friable and lighter in color. The sixth foot is a light buff to gray with fine iron stains throughout. This soil is of loessial origin and is free from stones.

LOCATION B, 3 MILES SOUTH OF LINCOLN, NEBR.

Butler silt loam

The topsoil of the Butler silt loam is very dark brown and is fairly well supplied with organic matter to a depth of about 12 inches. The surface soil is friable and easily cultivated. The color becomes lighter and the texture heavier to 20 inches. Below this to about 32 inches there is a heavy clay layer. This is very plastic when wet and breaks into blocks when dry. Below this heavy layer the soil again becomes more friable and is lighter in color. This soil usually occurs on fairly level areas, but there was considerable slope at the location where these tests were made.

LOCATION C, RALSTON, NEBR.

Marshall silt loam (eroded phase)

Most of the original dark surface soil had been removed by erosion, and the brownish loess material, containing some organic matter, was exposed. The lower profile consisted of unweathered loess and is reddish buff. At about 2 feet there is some evidence of accumulation of fine material but this is not yet very marked. Below this is a more yellowish to gray material of the Peorian loess.

LOCATION D, 4 MILES SOUTHEAST OF BLAIR, NEBR., ON FIRST BLUFFS, ALONG THE MISSOURI RIVER

Knox silt loam

The surface soil of this Knox silt loam is a brown friable silt loam. It contains only a limited amount of organic matter since it is in a field that had been cultivated for 30 to 40 years. At 6 to 10 inches the soil grades into a yellowish-brown to a buff silt loam subsoil. At 2 to 3 feet the subsoil is a lighter yellowish color and is a loose silt loam.

LOCATION E, EAST OF AGRONOMY FARM, LINCOLN, NEBR.

Marshall silt loam (heavy subsoil)

This soil is very similar to the Marshall silt loam at location A, but the subsoil is not so heavy and the surface has suffered somewhat less from erosion. The land has been farmed 60 to 70 years.

LOCATION F, VIRGIN GRASSLAND IN MEADOW PLOT, 40 RODS WEST OF LOCATION E

Marshall silt loam (heavy subsoil)

This soil is very similar to the soil at location E, but it has a slightly heavier subsoil, and the native sod has never been plowed. The surface soil is higher in organic matter.

LOCATION G, 10 MILES SOUTHWEST OF LINCOLN, NEBR.

Butler silty clay loam

The surface soil at this location is a dark brown silty clay loam to a depth of 10 to 12 inches. Below this the soil is a grayish silty material to about 20 inches, where it changes abruptly into a dark heavy compact claypan. This layer is very plastic when wet and hard and brittle when dry. Below this claypan is a more loose friable material becoming grayish to yellowish in color. Lime concretions are found in this portion of the subsoil.

LOCATION H, 9 MILES WEST OF LINCOLN, NEBR.

Pawnee clay loam

This soil has been developed on glacial drift and contains some coarse sand and gravel throughout the profile. The surface soil is a brown silty clay to clay loam. The structure is finely granular. The subsoil from 20 to 36 inches consists of a tough tobacco-brown claypan. When dry, the subsoil cracks badly and breaks into massive blocks. Below 36 inches the soil is still heavy but becomes somewhat more friable and lighter in color and contains lime concretions.

LOCATION I, 3 MILES NORTHWEST OF LINCOLN, NEBR.

Dickinson sandy loam

The soil at this location was not typical of Dickinson sandy loam but was rather a deposit of wind-blown sand about 8 inches deep, in which has accumulated a considerable amount of organic matter and fine material, which gives the soil a fairly dark color. The soil below this deposit is similar to the profile of the Marshall silt loam at location E.

LOCATION J, 3 MILES NORTHWEST OF LINCOLN, NEBR.

Lancaster sandy loam

The surface soil is a dark-brown very coarse sandy loam with considerable organic matter. At about 8 inches the soil becomes lighter brown and is more sandy. From 12 to 20 inches it is a lighter reddish brown in color and is very sandy. At 20 inches more clay is present. It continues through the fifth foot, and the soil becomes more yellowish. The sixth foot is more friable and contains less clay. This soil exhibits little structural development, and the profile on the whole is more nearly uniform than that of the other soils, except the Knox silt loam. This soil is formed from weathered Dakota sandstone.

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